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(54) Method and device in reeling of a paper or board web in a drum reel-up or equivalent

(57) The invention concerns a method in reeling of a paper or board web in a drum reel-up or equivalent, in which, when a paper or board reel (R) formed on a reel spool (11) becomes complete, a new reel spool (11') is brought by means of transfer members (32) into a stand-by position and accelerated up to the web speed, the reel spool (11) with the reel (R) is transferred by means of a transfer device into an exchange position apart from the reel drum (10), and the new, initially accelerated reel spool (11') is transferred into the reeling position (12). When the reel spool (11) with its reel (R) is transferred into the exchange position apart from the reel drum (10), the belt (F) guide roll (21) is transferred into contact with the reel (R) that is being formed onto the reel spool (11), that the guide roll (21) is displaced along with the reel spool (11) into the exchange position so that the web (W) runs during the entire exchange on support of the belt (F) and through the nip (N_3) between the guide roll (21) and the reel spool (11). The invention also concerns a device in reeling of a paper or board web in a drum reel-up or equivalent, which device comprises a reel drum (10) and a reel spool (11), the web (W) being fitted to run through the nip (N) between said drum and said spool onto the reel spool (11), which device comprises a transfer device (32) for bringing a new reel spool (11') into nip contact against the reel drum (10) after the paper or board reel (R) on the first reel spool has become complet . The device comprises means for the transfer of the belt (F) guid roll (21), together with the reel spool (11), into the exchange position, so that, during the entire exchange, the web (W) is supported on the belt (F) and fitted to run through the nip (N_3) between the guide roll (21) and the reel spool (11).

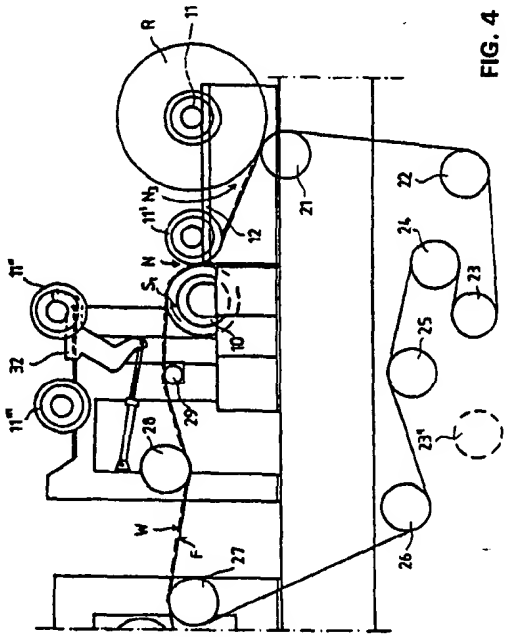

FIG. 4

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The invention concerns a method in reeling of a paper or board web in a drum reel-up or equivalent, in which, when a paper or board reel formed on a reel spool becomes complete, a new reel spool is brought by means of transfer members into a stand-by position and accelerated up to the web speed, the reel spool with the reel is transferred by means of a transfer device into an exchange position apart from the reel drum, and the new, initially accelerated reel spool is transferred into the reeling position.

Further, the invention concerns a device in reeling of a paper or board web in a drum reel-up or equivalent, which device comprises a reel drum and a reel spool, the web being fitted to run through the nip between said drum and said spool onto the reel spool, which device comprises a transfer device for bringing a new reel spool into nip contact against the reel drum after the paper or board reel on the first reel spool has become complete.

As is well known, when a web is reeled by means of a drum reel-up or an equivalent reel-up, the web is passed on the face of the mantle of a reel drum, a reeling cylinder or equivalent before the reeling nip, while the web forms a belt angle over the reeling cylinder or equivalent. Problems have arisen from sliding between the web and the reeling cylinder, which has caused fluctuation in the tension of the web. Further, in a situation of change of full reel, fluctuations have occurred in the tension of the web, which fluctuations may also have resulted in problems in the process preceding the reeling.

A drum reel-up is used commonly to reel the paper web that comes, for example, from a paper machine, a coating machine, a supercalender and from a printing machine. Therein the web is reeled onto a spool, and the reel that is being formed is pressed against the reel drum or reeling cylinder, over which the web runs on a certain sector and which is rotated at a circumferential speed that corresponds to the speed of the web. Before completion of the reel, a new spool can be brought into nip contact with the reel drum so that it also obtains the corresponding circumferential speed. As soon as the reel of paper has obtained the desired diameter, it is transferred apart from the reel drum. Then its speed of rotation starts becoming lower, which has the consequence that, between the new reel spool and the full reel, a web loop is formed. This loop is guided, for example, by means f a compressed-air jet to be wound around the new reel spool, whereby it is torn apart from the full reel of paper.

As is well known, at the reeling stage, normally, the spool of the paper reel rests and revolves on two support rails. To permit that, there are particular bearing parts at its ends, which bearing parts also guide the transfer of the reel as it is, upon its completion, transferred along said rails to further processing. In paper manufacture, this further processing is usually slitting, in which the reel is cut and unwound into smaller rolls. The returning and changing of the empty reel spools can be carried out, for example, by means of a crane.

When certain paper grades, for example LWC and SC, are being reeled, especially at higher speeds, it has been a problem that the paper to be reeled slides on the face of the reeling cylinder. This sliding problem occurs especially in the reel-ups driven by the circumference described above, in which the growing new paper reel obtains the power required for the rotation from the circumference of a driven reeling cylinder to its own circumference through the friction force between the paper and the face of the reeling cylinder. When said friction force is lower than a certain limit value, sliding occurs between the face of the reeling cylinder and the paper to be reeled, which again results in uncontrollable variations in tightness and hardness in the paper reel that is being formed. These variations in tightness and hardness produce wrinkles in the reels, especially in the inner layers, so that the inner portion of the reel becomes broke. This again causes substantial economic losses for the paper mill.

The above sliding of the paper against the face of the reeling cylinder depends on the tension of the paper in the area of the reeling cylinder and on the resulting surface pressure against the face of the reeling cylinder. Another factor that affects the sliding is the linear load that is produced by the primary and secondary reeling forks on the growing paper reel against the reeling cylinder. Further, the arising of sliding is affected by the surface properties of the paper that is reeled and of the reeling cylinder, i.e. the friction coefficient between said surfaces, which is also affected by the humidity of the paper.

An increased tension of the paper increases said tendency of sliding, but, on the other hand, it reduces the fluttering. However, in the form of increased breaks, the tensile strength of the paper sets an upper limit for an increase in tension. Keeping the linear load between the reel that is being formed and th reeling cylinder sufficiently high and stable is complicated because the reeling is started on primary forks that are in the upper position and is continued on secondary forks in a later stage. The primary forks bring the reel downwards to an inclined contact with th face of the reeling cylinder, and the reel begins to receive its rotation power from the circumference of the reeling cylinder. As the reel becomes larger and the primary forks are lowered gradually to their lower position, attempts are made to keep th linear load between the reel and the reeling cylinder invariable despite a reduction in the force component arising from the gravity of earth as the position of the growing reel changes in relation to the reeling cylinder. This takes place by means of separate relief cylinders.

The most difficult part of the control of said linear

load is the stage in which the growing reel is transferred from th primary forks to the secondary forks. In practice, in said stage, there are remarkable variations in the linear load, which variations again permit momentary sliding of the paper on the face of the reeling cylinder. This results, from time to time, in the above wrinkling of the paper in the initial stage of the reeling.

At the reeling stage, for example drum reeling, the transfer from primary forks to secondary forks causes discontinuity in the reeling of the web and, as a result, bottom broke in the paper reel.

The transfer of the reel from primary forks to secndary forks may also cause variation in the tension of the paper, which variation may be a reason for sliding and for wrinkling of the paper.

One of the prior-art means for avoiding the above sliding problem and its consequences is to set the tension of the paper as low as possible by regulating the difference in speed between the reeling cylinder and the nearest drive mechanism preceding it. As was stated above, in this connection, a restricting factor is the fluttering of the web and the resulting increased tendency of breaks and deterioration of the quality properties of the paper, for example formation of folds.

As is well known, another means that is used is an increase in the linear load between the growing reel and the reeling cylinder to a level as high as possible by using an excessively high loading force on the carrier forks, especially on the secondary forks, with which loading force the reel is pressed against the reeling cylinder. Reduced quality properties of the paper are a drawback in this procedure, because especially the tensile strength and the stretch are reduced.

With respect to the prior art most closely related to the solution in accordance with the present invention, reference is made to the FI Patent Application No. 905284, in which a method in reeling is described, wherein, when the machine roll becomes full, a new reel spool is brought by means of transfer members into the stand-by position and accelerated to the web speed. At the same time as the machine roll connected to the centre drive is transferred by means of the machine roll transfer device to the exchange position apart from the reel drum, the new pre-accelerated reel spool is lowered onto the rails, and the exchange is carried out in a way in itself known. Hereupon the full machine reel is slowed down and the transfer device for full machine reel is shifted to the new reel spool, and the centre drive is connected to the new reel spool.

From the prior art, so called WINBELT reel-ups are also known, in which reel-ups a carrier belt, which runs between belt rolls, is used. One of these belt rolls is usually provided with a drive and the other belt roll is mounted on fastenings. Th positions of the belt rolls are substantially stationary, and their position is changed only to the extent that is required to adjust the tension of the belt. By means of this arrangement of belts, attempts are made to provide a difference in speed in relation to the reeling, and by means of th difference in speed, attempts are made to provide optimal linear loads as the reeling makes progress.

With the present paper and surface treatment machines, attempts are made to achieve ev r higher speeds, so called high-speed reeling, in which reeling the speed is higher than 1600 metres per minute. High-speed reeling results in increased air resistance and friction, for example, an increase in speed makes the air resistance four-fold, which may cause problems for the running of the web. While aiming at ever higher speeds, attempts are made to use recycled fibres as extensively as possible, which fibres are, however, not as strong as virgin fibres, and further, at the same time, attempts are made to provide thinner paper grades, in which case the paper grade that is used is weaker. In such cases, it is important to arrange the exchange in such a way that there is no discontinuity in the reeling of the web, and at the same time, the control of the reeling parameters is emphasized even further.

The object of the present invention is to provide a solution for the above problems in the exchange in reeling. A further object of the invention is to improve the structure of the reel and to provide a stable running of the web during reeling, reel changes and threading.

In view of achieving the objectives stated above and those that will come out later, the method of invention is mainly characterized in that, when the reel spool with its reel is transferred into the exchange position apart from the reel drum, the belt guide roll is transferred into contact with the reel that is being formed onto the reel spool, that the guide roll is displaced along with the reel spool into the xchange position so that the web runs during the entire exchange on support of the belt and through the nip between the guide roll and the reel spool.

The device in accordance with the inv ntion is mainly characterized in that the device comprises means for the transfer of the belt guide roll, together with the reel spool, into the exchange position, so that, during the entire exchange, the web is supported on the belt and fitted to run through the nip between the guide roll and the reel spool.

The most essential feature of the arrangement in accordance with the invention is the web transfer supported until the nip, which makes high-speed reeling possible also with weaker paper or board grades.

The invention can be applied both to threading and to supporting the web and to controlling the reeling parameters. The invention is also particularly favourable in connection with reel change, because the web is supported by the belt during the whole of the change.

By means of a belt arrangement in accordance with the invention, an extended nip is provided, and the nip pressure can be made, for example, lower, because the length of the nip is proportional to the tension of the web used. By means of this belt effect, the reeling geometry can be regulated.

In threading, the arrangement in accordance with the invention supports the leader strip of the web in its running, and it is possible to use a wedge strip made in the middle or at the edge, and the leader is supported through the whole of the threading.

The belt roll guiding the belt can be closed or open. Thus, the belt arrangement in accordance with the invention can also form an extra nip, which prevents access of air into the reeling nip.

In the following, the invention will be described in more detail with reference to the figures in the accompanying drawing, the invention being, however, not supposed to be strictly confined to the details of the illustrations in said figures.

Figure 1 is a schematic illustration of the stage in the reeling in which the machine reel is becoming full.

Figure 2 is a schematic illustration of the change that takes place in reeling while the reel spool is in the stand-by position.

Figure 3 is a schematic illustration of a stage in the change in reeling in which the machine reel is in the change position.

Figure 4 is a further illustration of a situation of change in which both the reel spool and the machine reel are in the change position.

Figure 5 is a schematic illustration of the stage of the change in the reeling, in which the change has taken place and the web moves to the new reel spool.

Figure 6 is a schematic illustration of an alternative mode of change in reeling.

Figure 7 is a schematic illustration of another alternative mode of change in reeling.

Figure 8 is a schematic illustration of a further alternative mode of change in reeling.

Figure 9 is a schematic illustration of a further alternative mode of change in reeling.

Figures 1...5 present a comic type illustration concerning the change of reeling, in which illustration the change of reeling is presented while referring to a drum reel-up, in which drum reel-up the main part of the reel-up is formed by the reeling cylinder 10, along whose circumference the paper web W runs before being transferred onto the circumference of the paper reel R that is formed around the reel spool 11. The spool 11 rests and revolves in its reeling position, for example, on two carrier rails 12. The belt arrangement in accordance with the invention comprises a belt F, which can be a wire, felt or any other fabric permeable to air. The belt F runs under guidance of the guide rolls 21...29 and through the nip N between the reeling cylinder and the paper reel R. The belt F supports the paper web W as the web comes into the reeling device and until the paper web W is wound around the paper reel R that is being formed on the reel spool 11. The belt F extends in the cross direction substantially across the whole of the machine width.

All reeling cylinder types known in themselves, for example grooved, perforated, smooth cylinders, can be used in the arrangement in accordance with the invention. Suction roll solutions are also possible. A grooved reeling cylinder is preferable, for then it is easier to control the air flows in the area of the nip. In the present specification, besides to a conventional linear nip, the term nip also refers to a support zone.

In the stage of Fig. 1, the reeling cylinder 10 revolves in the direction indicated by the arrow S_1, and the web W is reeled onto the reel shaft, i.e. the reel spool 11. The web W is reeled onto the reel spool 11 by means of the reeling cylinder 10 through the nip N. The reel spool 11 revolves in the direction indicated by the arrow S_2. The paper reel R that is formed on the reel spool 11 is almost full, and the transfer members 32 have brought a new reel spool 11' to the stand-by position. The guide roll 21, which functions as a rider roll at the same time, is in the stand-by position near the reel spool 11. Supported by means of the belt F, the paper web W runs from the reeling cylinder 10 onto the paper reel R that is formed on the reel spool 11. The belt F forms an extended nip N_2 between the reeling cylinder 10 and the paper reel R, the length of the nip N_2 being adjustable by means of the guide roll 21 and the belt arrangement.

In the stage of Fig. 2, the paper reel R, formed on the reel spool 11 which revolves on the rails 12, is almost full. When the paper reel R becomes full, a new reel spool 11' is brought by means of the transfer members 32 to the stand-by position, and the new reel spool 11' is accelerated to the web speed. The paper web W still runs supported by the belt F.

In the stage illustrated in Fig. 3, the reel spool 11 with the full paper reel R has been transferred in some way in itself known to the exchange position, and the guide roll 21 has been brought into contact with the paper reel R that has been formed on the reel spool 11, in order to provide an additional nip N_3 to prevent air from entering into the paper reel R and, at the same time, in order to shift the running of the belt F in such a way that the paper web W is also supported on the run between the reeling cylinder 10 and the reel spool 11. The guide roll 21 is brought into its position before the reel spool 11 is separated from the reeling cylinder 10, and it is transferred along with the complete paper reel R to the exchange position.

In accordance with Fig. 4, a new initially accelerated reel spool 11' is lowered to the reeling position, for example onto the rails 12, and the change takes place by means of normal known methods, and the reel spool 11' has been transferred to the stand-by position in order to begin new reeling. The paper web W still runs supported by the belt F onto the complete

paper reel R.

In the situation shown in Fig. 5, the change has taken place and the paper web has been cut off between the complete paper reel R and the reel spool 11', and the paper web W is wound onto the new reel spool 11'. As is shown in Fig. 5, the new reel spool 11' has been brought into contact with the reeling cylinder 10, and the new reel spool 11' revolves at the web speed. The full paper reel R on the reel spool 11 is slowed down, and the transfer members 32 have been brought back to their initial position in order to transfer the next reel spool 11" to the stand-by position for the next change.

As is shown in the figures, it is possible, for example by means of the guide roll 23, to adjust the tension of the belt F, e.g., from its position 23' indicated by the dashed line to the position 23". Thus, the reeling parameters can be adjusted by adjusting the tension of the belt F. Of course, the change in the length of the belt is also compensated for by means of the guide roll 23 when the guide roll 21 is transferred to the exchange position along with the complete paper reel R, Figs. 3...5. The belt F runs, guided by its guide rolls 21...29, substantially at the same speed with the reeling. In Fig. 1, the dashed line downwards from the guide roll 22 represents a situation in which, if necessary, the paper web W is passed into the pulper.

In the arrangement in accordance with the invention, an elastic belt can also be used, in which case the guide roll 23 does not have to compensate for the changes in the length of the belt F in a situation of change.

In Fig. 6, an alternative mode of change in reeling is shown schematically concerning a situation that takes place between the stages illustrated in Figs. 4 and 5. The web W that runs supported by the belt F is separated from the belt F after the new reel spool 11' by again blowing air through the belt F and simultaneously slowing down the centre drive 45 of the reel spool 11 of the complete paper reel R, in which case the web W is separated from the belt by the effect of the blows from a blowing device 40, and it can be cut off in a way in itself known, for example, by means of water-jet cutting or a cutter blade.

In Fig. 7, an alternative mode of change in reeling is shown schematically concerning a situation that takes place between the stages illustrated in Figs. 4 and 5. In the example shown in Fig. 7, the web W supported by the belt F is separated from the belt F by blowing by means of the blow device 50 from the edges in the plane of the paper web W. The web W is separated from the b lt F and can be cut off, .g., by means of a cutter blade, water-jet cutting or any other method in itself known, whereby th web is cut off at the point C and the final end of the web is wound around the complete reel R, and the end of the web placed at the other side of the cutting point is blown by the blow device 50 to turn around the new reel spool 11'.

Fig. 8 shows an example of change in reeling in which, for example, by means of a roll 60 to be raised in the direction of the arrow U, the new reel spool 11' can be surrounded by the belt F. The paper web W is cut by means of the water jet from the water-jet cutting device 62, and the leader of the web W is blown by means of the blow device 64 to follow the face of the new reel spool 11, and the final end of the web W is wound around the complete reel R.

Fig. 9 shows an example of change in reeling in which, by means of the water-jet cutting equipment 71, a wedge shaped leader W_N is formed on the web W supported by the belt F, which leader is either wound around the new reel spool 11' by means of the air-blow device 72 placed above, or the wedge-shaped leader W_N is blown to be wound around the new reel spool 11' by the air-blow device 73 blowing through the belt F permeable to air. Both of the air-blow equipments 72,73 can also be used to wind the leader W_N around the new reel spool 11'. In order to keep the web W in contact with the belt F, near the reeling cylinder 10, for example before the reeling cylinder 10, a suction zone 74 is provided and/or the suction zone is provided in the reeling cylinder 10 as is denoted by the reference numeral 75. In stead of the water-jet cutting equipment 71, a cutting slash can be made into the web W, in which case it is advantageous to use both the upper and the lower air-blow equipment 72,73 to wind the leader W_N of the web W onto the new reel spool 11'. The end W_E of the web W runs supported by the belt F and is reeled onto the reel that is being completed.

The different modes of change shown abov in Figs. 6...9 can be combined in various ways with respect to air-blows, centre-drive slow-downs and cutting applications. Of course, the cutting can als be carried out by some other means except by the water-jet cutting shown in the figure. A cutting slash can also be made into the web before the reeling cylinder for the change.

Above, the invention has been described by way of example with reference to the exemplifying embodiments illustrated in the figures in the accompanying drawing. The invention is, however, not confined to the exemplifying embodiments illustrated in the figures alone, but different embodiments of th invention are possible within the scope of the inventive idea defined in the accompanying claims.

Claims

1. Method in reeling of a paper or board web in a drum reel-up or equivalent, in which, when a paper or board reel (R) formed on a reel spool (11) becomes complete, a new reel spool (11') is brought by means of transfer members (32) into

a stand-by position and accelerated up to the web speed, the reel spool (11) with the reel (R) is transferred by means of a transfer device into an exchange position apart from the reel drum (10), and the new, initially accelerated reel spool (11') is transferred into the reeling position (12), characterized in that, when the reel spool (11) with its reel (R) is transferred into the exchange position apart from the reel drum (10), the belt (F) guide roll (21) is transferred into contact with the reel (R) that is being formed onto the reel spool (11), that the guide roll (21) is displaced along with the reel spool (11) into the exchange position so that the web (W) runs during the entire exchange on support of the belt (F) and through the nip (N_3) between the guide roll (21) and the reel spool (11).

2. A method as claimed in claim 1, characterized in that the belt (F) runs substantially at the same speed with the reeling.

3. A method as claimed in claim 1 or 2, characterized in that, when the web (W) is changed to be reeled onto the new reel spool (11'), a substantial proportion of the circumference of the new reel spool (11') is made to be surrounded by the belt (F) and the web (W) by transferring the belt (F) by means of a roll (60) to guide the web (W) around the new reel spool (11').

4. A method as claimed in any of the claims 1...3, characterized in that, when the web (W) is changed to be reeled onto the new reel spool (11'), the web (W) is cut off by a water-jet cutting device (62) and the leader of the web (W) is blown to follow the face of the new reel spool (11'), and the final end of the web (W) is wound around the complete reel (R).

5. A method as claimed in claim 1 or 2, characterized in that, when the reeling is changed onto a new reel spool (11'), a leader (W_N) is cut on the web (W) by a water-jet cutting device (71), and that the leader (W_N) of the web is blown by an air-blow device or devices (72,73) to follow the face of the new reel spool (11'), the web (W) is cut off, and the reeling takes place onto the new reel spool (11'), and the final end (W_E) of the web (W) is wound around the complete reel.

6. A device as claimed in claim 5, characterized in that, when the reeling is changed onto the new reel spool (11'), the web (W) is held in contact with the belt (F) by means of a suction zone or suction zones (74,75).

7. Device in reeling of a paper or board web in a drum reel-up or quivalent, which device comprises a reel drum (10) and a reel spool (11), the web (W) being fitted to run through the nip (N) between said drum and said spool onto the reel spool (11), which device comprises a transfer device (32) for bringing a new reel spool (11') into nip contact against the reel drum (10) after the paper or board reel (R) on the first reel spool has become complete, characterized in that the device comprises means for the transfer of the belt (F) guide roll (21), together with the reel spool (11), into the exchange position, so that, during the entire exchange, the web (W) is supported on th belt (F) and fitted to run through the nip (N_3) between the guide roll (21) and the reel spool (11).

8. A device as claimed in claim 7, characterized in that the device comprises members for changing the places of the guide rolls (21,23;121) so as to adjust the tension of the belt (F).

9. A device as claimed in claim 7 or 8, characterized in that the device comprises a cutting device (62,71) for cutting off the web (W) when the reeling is changed onto the new reel spool (11'), and that the device comprises an air-blow device or devices (64,72,73) so as to blow the leader (W_N) of the web (W) to follow the face of the new reel spool (11').

10. A device as claimed in any of the claims 7 to 9, characterized in that the device comprises a roll (60), by whose means the web (W) and the belt (F) that supports the web are transferred so that they surround a substantial proportion of the circumference of the new reel spool (11').

11. A device as claimed in claim 7 or 8, characterized in that the device comprises a cutting device (71) before the reeling cylinder (10) for cutting the web (W) as the reeling is changed onto th new reel spool (11'), that the device comprises an air-blow device/devices (72,73) for winding th l adder (W_N) of the web (W) around the new reel spool (11').

12. A device as claimed in claim 11, characterized in that the device comprises a suction zone/zones (74;75) in connection with, or substantially close to, the reeling cylinder (10) to keep the web (W) in contact with the belt (F) as the reeling is changed onto the new reel spool (11').

13. A device as claimed in any of the preceding claims, characterized in that the belt (F) is a wire, felt, or any other, equivalent fabric permeable to air.

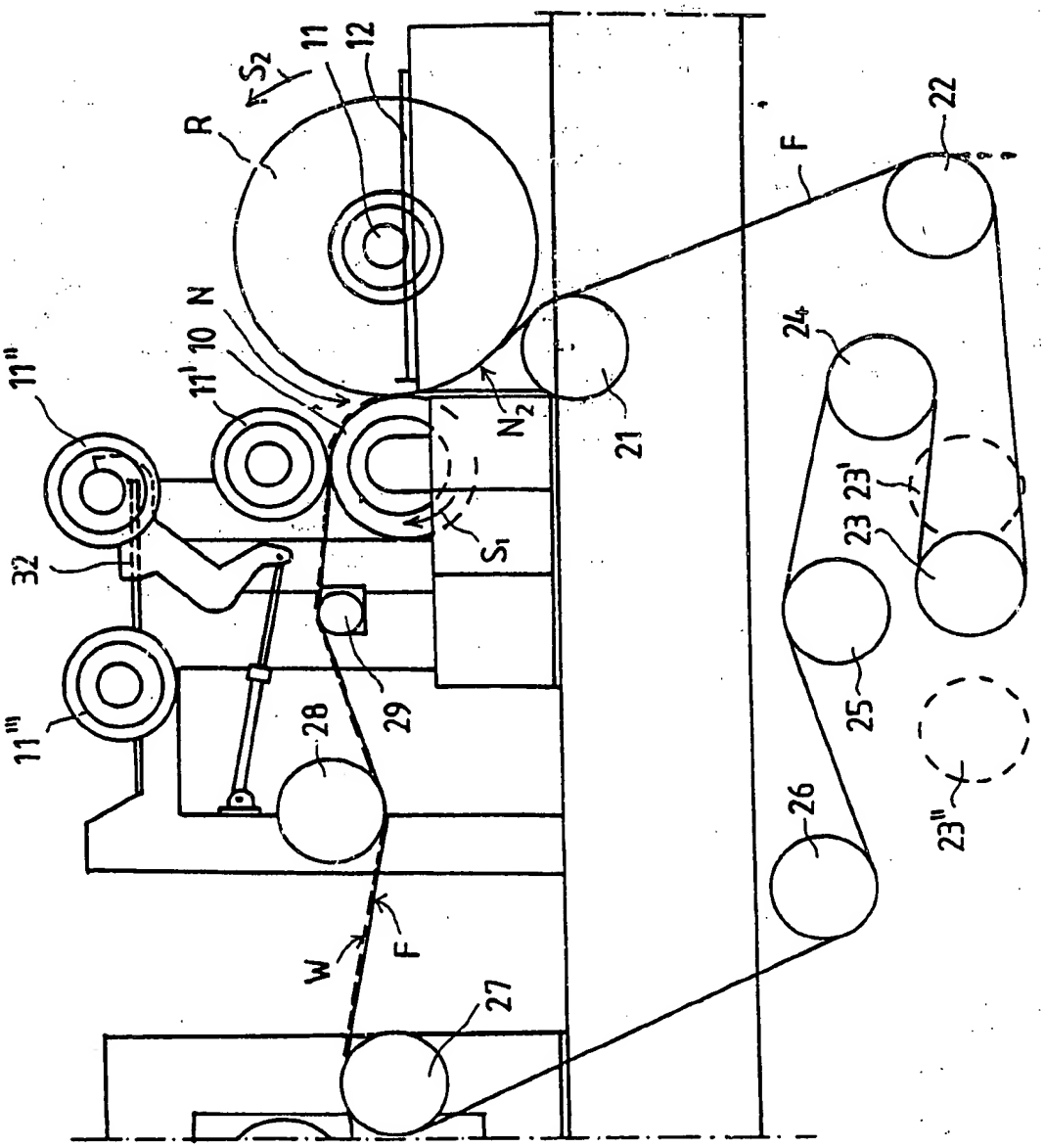

FIG. 1

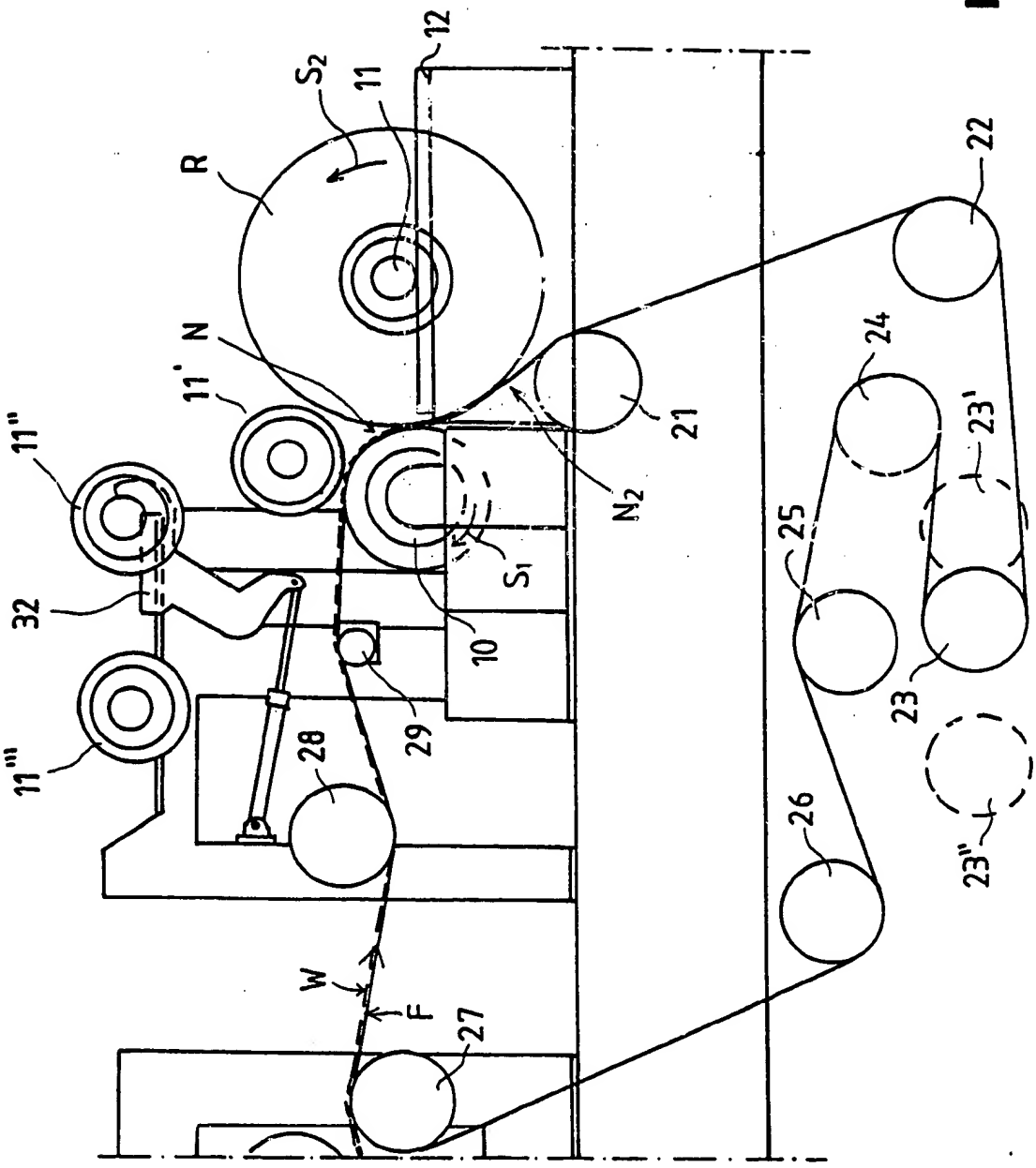

FIG. 2

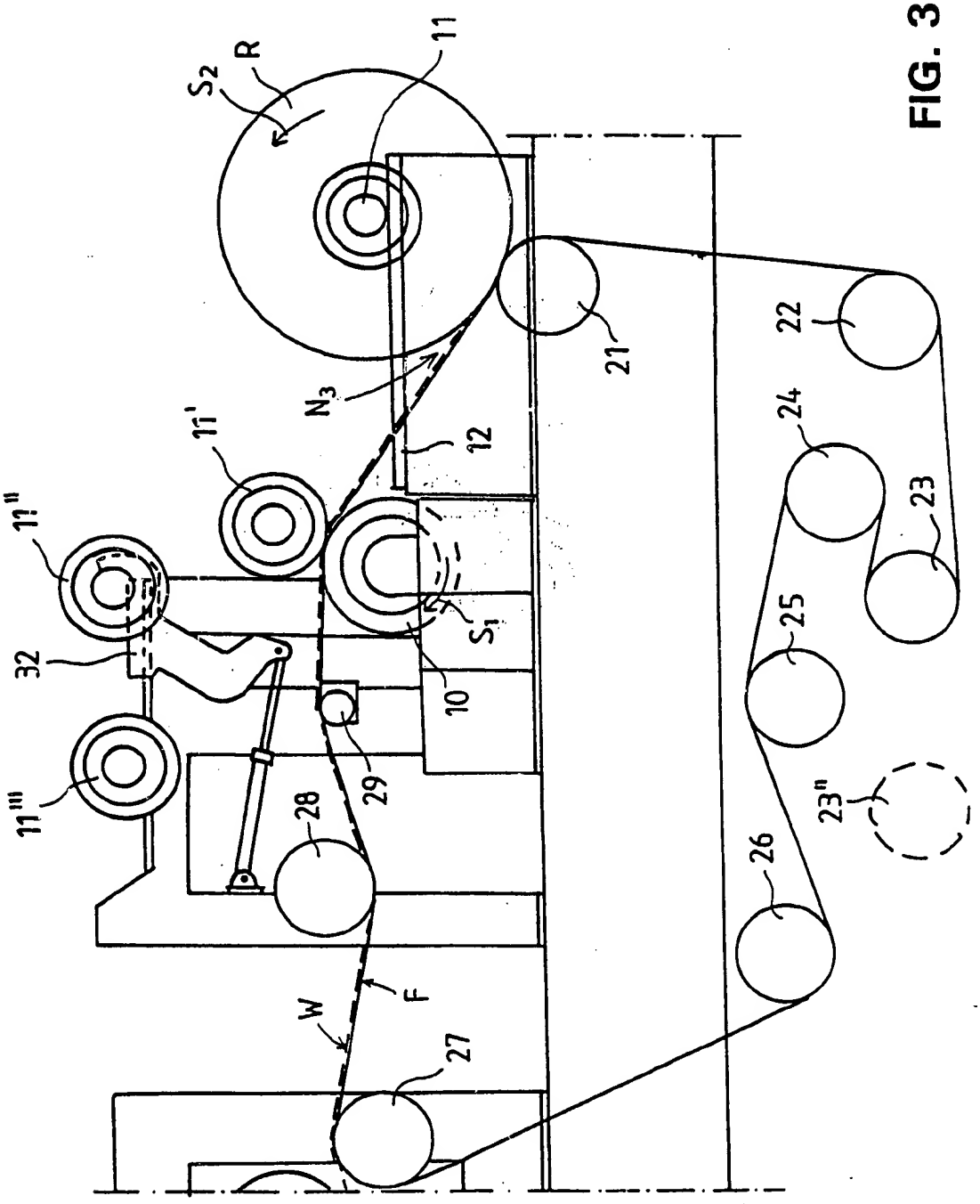

FIG. 3

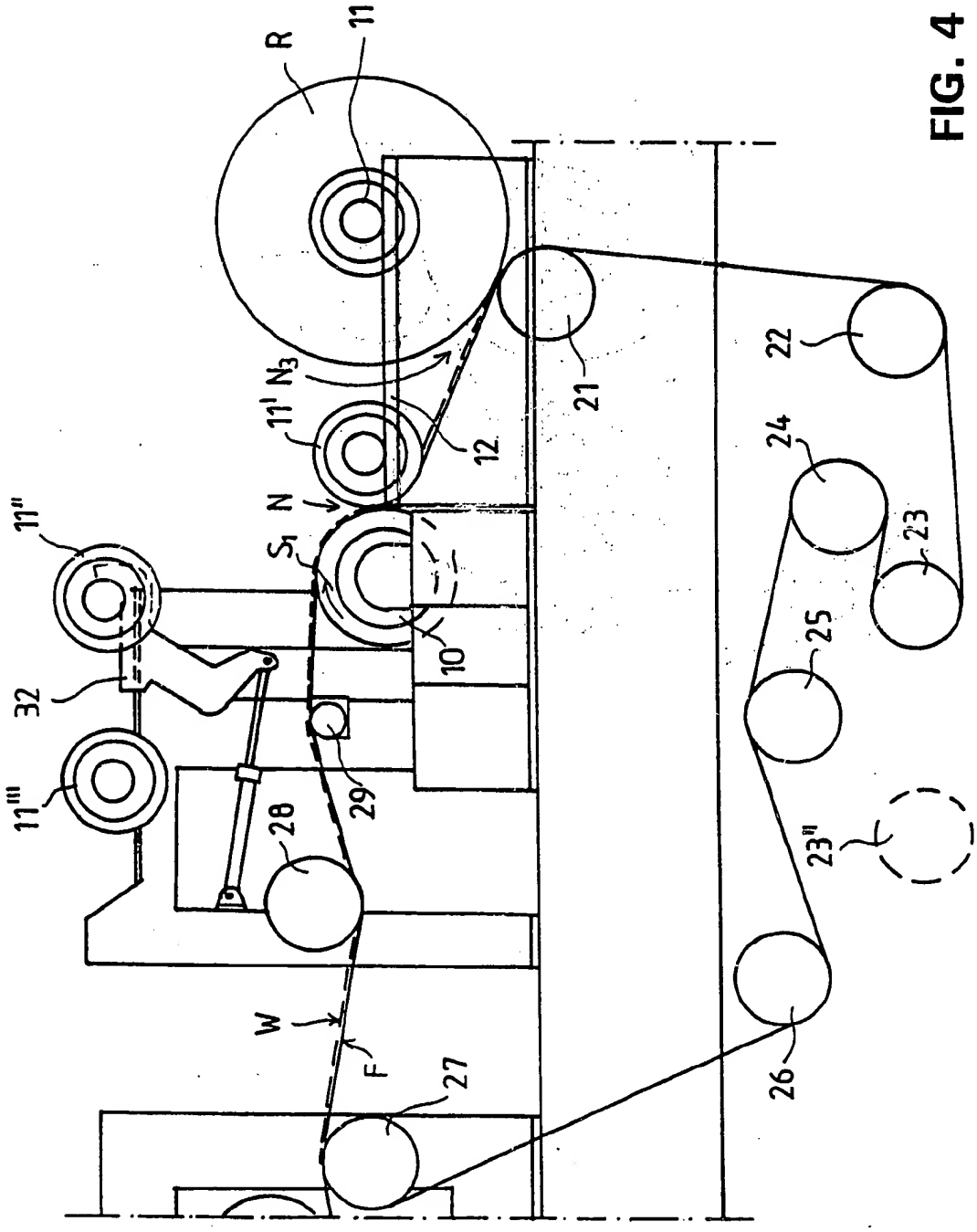

FIG. 4

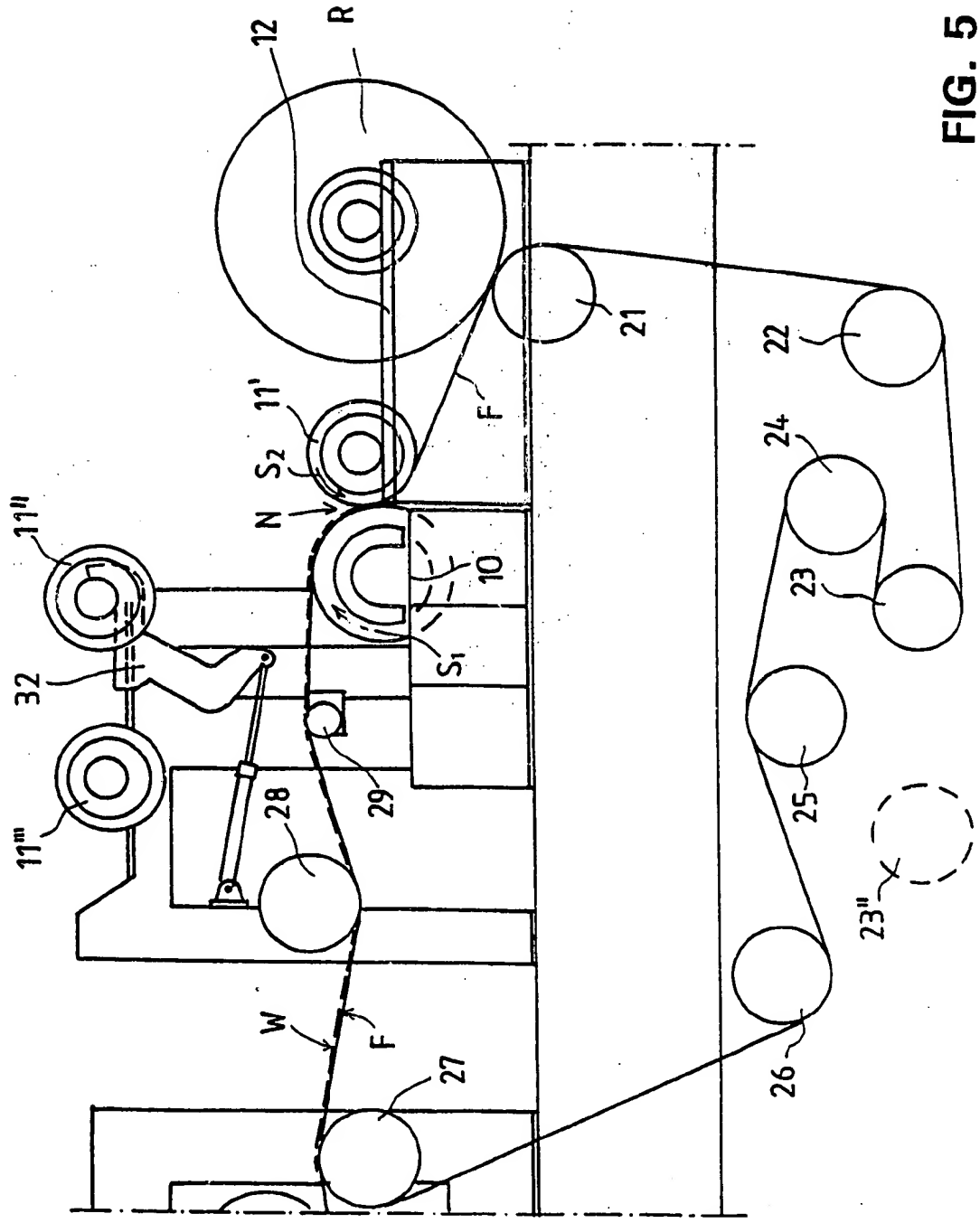

FIG. 5

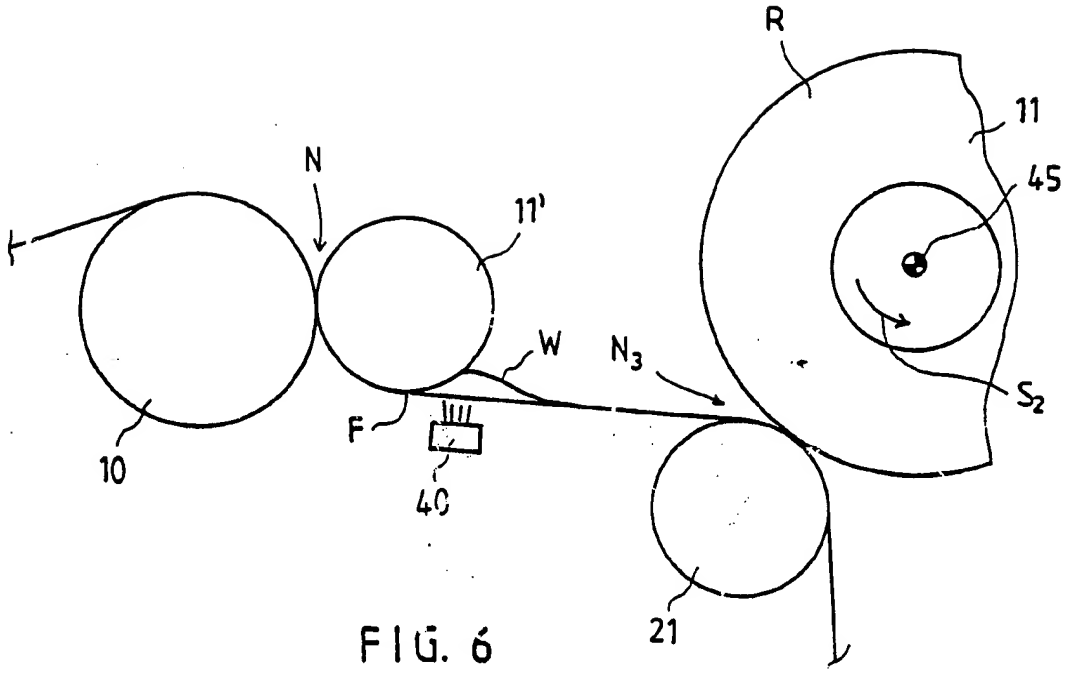

FIG. 6

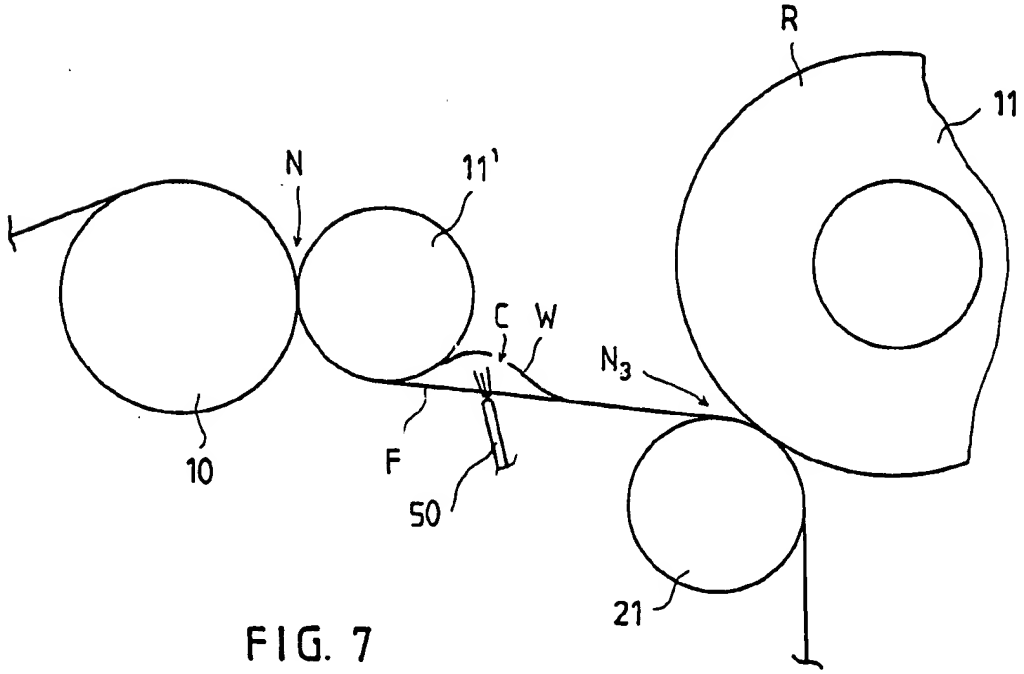

FIG. 7

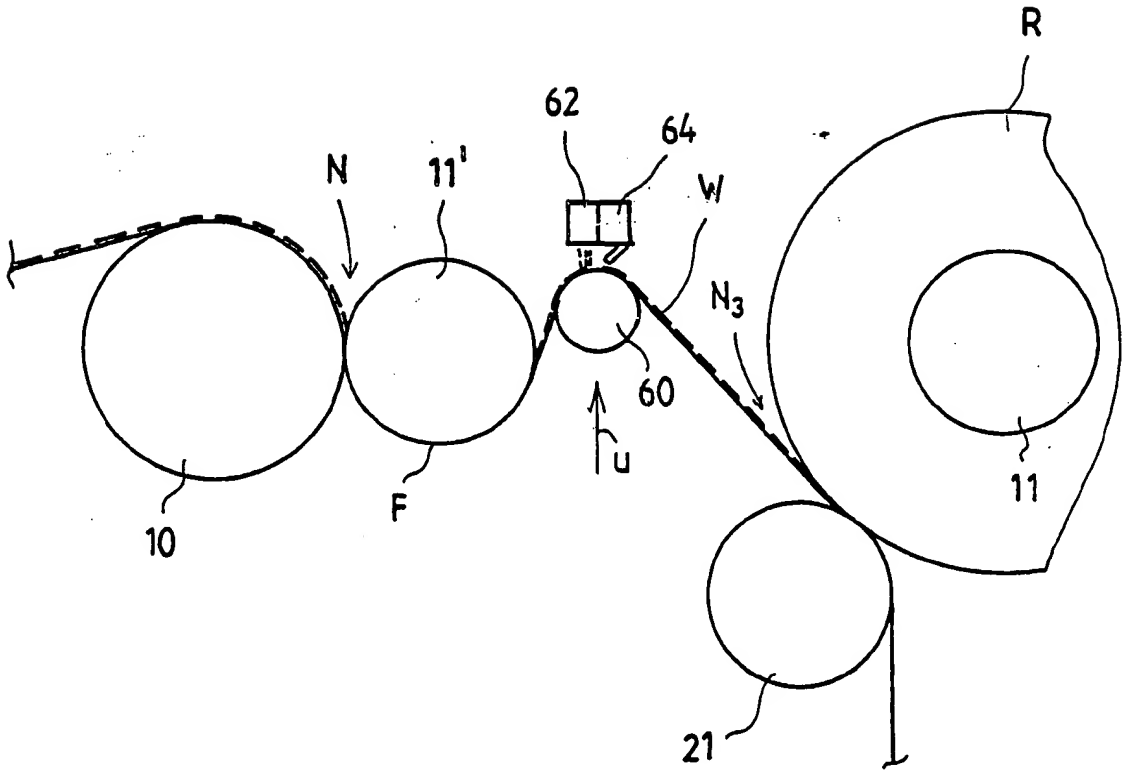

FIG. 8

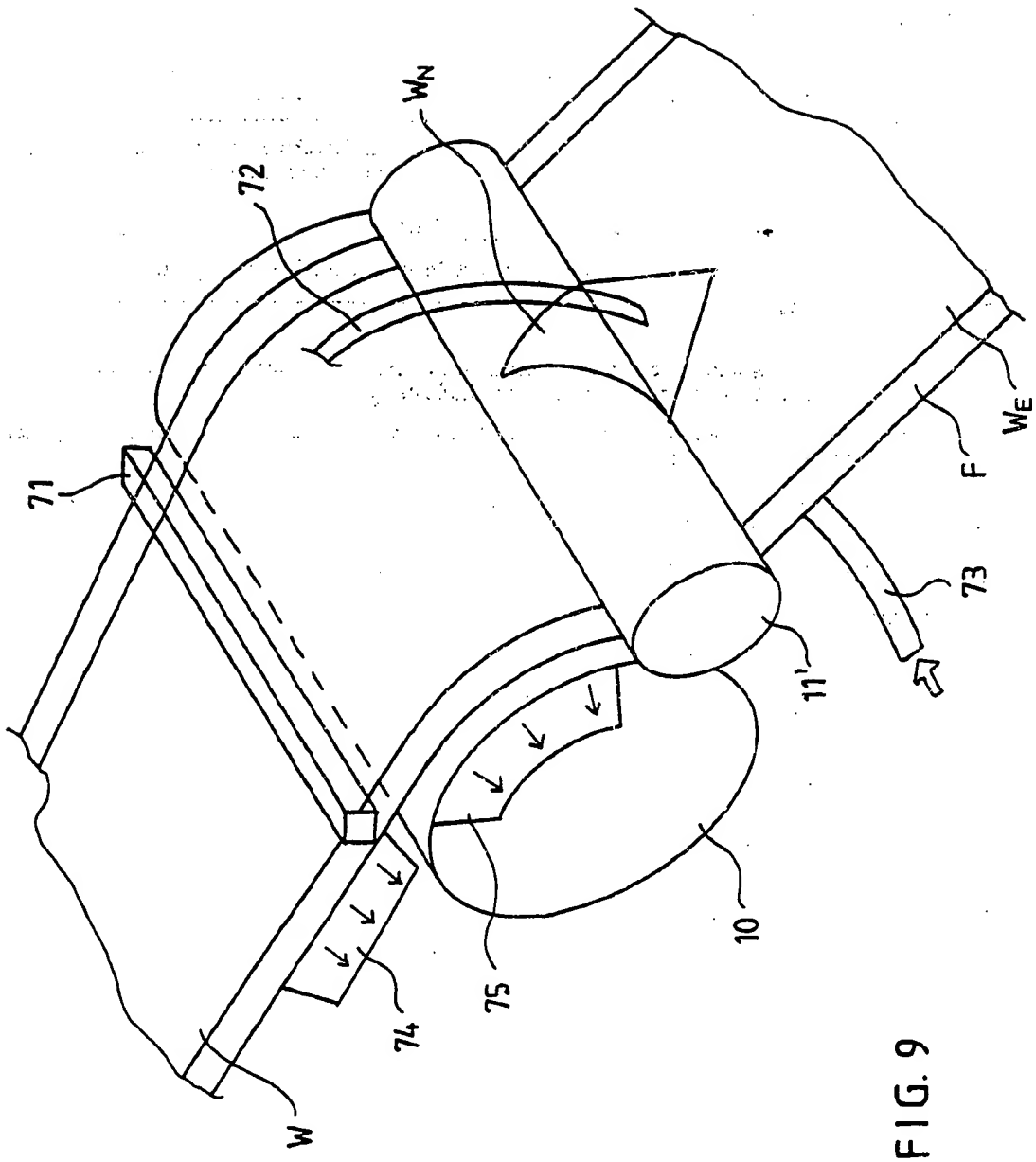

FIG. 9